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AND PROGRAM PLAN. VOLUME 1: PROJECT
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AGRICULTURE AVIATION STUDY and PROGRAM PLAN

VOLUME I. PROJECT SUMMARY

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

6 JUNE 1976



**AGRICULTURE
AVIATION STUDY
and
PROGRAM PLAN**

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FOREWORD

This is Volume I of a two-volume final report that presents:

- An assessment of the impact of agricultural aviation on agricultural productivity
- An assessment of the technology needs of agricultural aviation
- A proposed program plan by which NASA technology can be utilized to improve the performance of current agricultural aircraft.

Volume I—Project Summary, presents significant findings and recommendations in brief. Part I discusses the Ag-Air Study; Part II presents the Ag-Air Program Plan. Volume I is designed in a story-book format. Text on the right-hand pages complements the graphics and other information depicted on the left-hand pages.

Volume II—Supplemental Information, provides a more detailed presentation of the study results and of the program plan.

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**Agricultural
Aviation
Study**

PART I

STUDY OBJECTIVES

The objectives of the Agricultural Aviation (Ag-Air) Study were to:

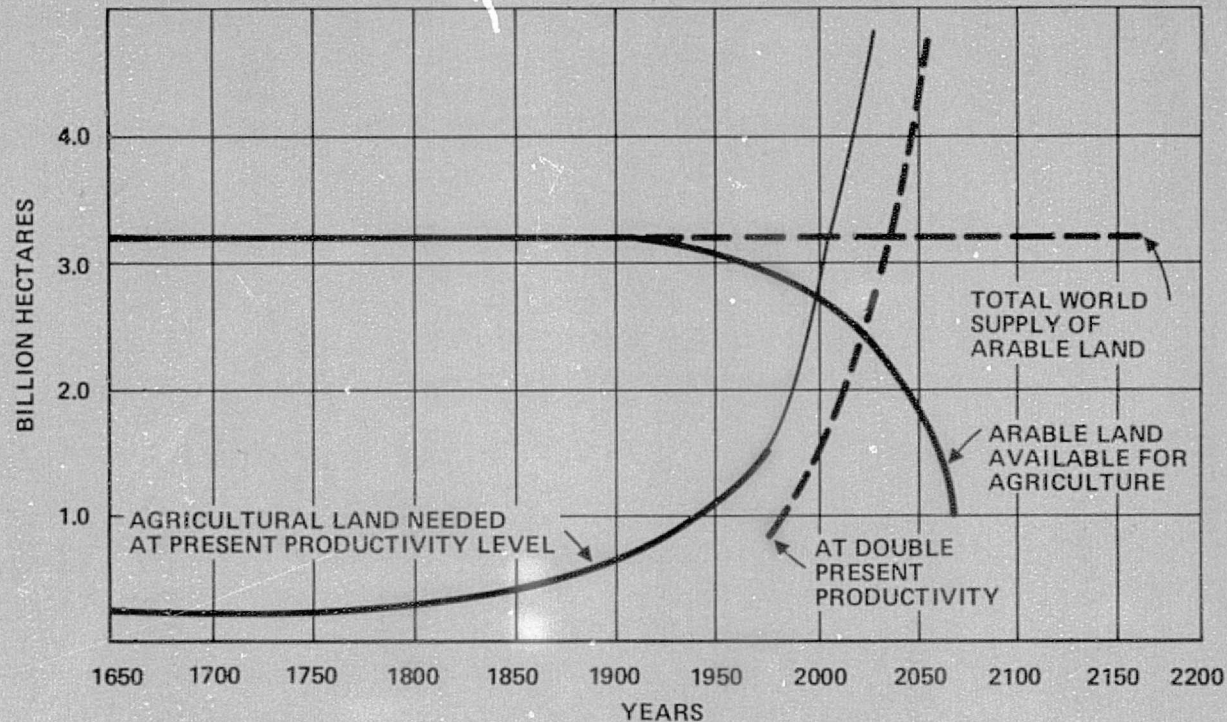
- Analyze Ag-Air including the current and potential impact of Ag-Air on agricultural productivity
- Determine what role NASA Research and Technology (R&T) might play in Ag-Air's future development.

STUDY TEAM

NASA In-House:	R. Price	—NASA Consultant
	R. Winblade	—OAST
	J. Mullin	—OAST

Contract:	Operations Research, Inc. (ORI)
	P. Steen
	M. McDermott
	L. Kaplan
	R. Kupersmith

WORLD SUPPLY OF ARABLE LAND



WORLD FARM PRODUCTIVITY GRAIN PRODUCTION - 1972

COUNTRY	PRODUCTION (TONS)	PERSONS IN AGRICULTURE	TOTAL POPULATION
UNITED STATES	239 MILLION	8 MILLION	209 MILLION
SOVIET UNION	200 MILLION	77 MILLION	247 MILLION
CHINA	168 MILLION	514 MILLION	800 MILLION
INDIA	105 MILLION	364 MILLION	563 MILLION

AGRICULTURAL PRODUCTIVITY—A WORLD-WIDE CONCERN

WORLD SUPPLY OF ARABLE LAND

- One-half of the world supply of arable land is in production.
- Remaining land will require immense capital inputs to reach, clear, irrigate or fertilize before it can produce food. According to an FAO report, it is not economically feasible to open more land to cultivation even given the pressing need today.
- In the year 2000, the land needed (at present productivity levels) will exceed the land available.
- Doubling present productivity will delay the problem 50-60 years.
- Ag-Air can increase productivity by some smaller percent and buy 10-20 years in which to develop additional solutions.

WORLD FARM PRODUCTIVITY

World grain production varies significantly. India and China do not come close to supplying enough food for their populations. Their farmers are barely feeding themselves. Thus, the need for Ag-Air (as well as other improvements) is great.

U.S. FARM PICTURE

1940 — 1974

POPULATION

30 MILLION



1940

8 MILLION



1974

NUMBER OF FARMS

6.5 MILLION



1940

2.8 MILLION



1974

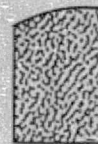
FARM SIZE

170 ACRES



1940

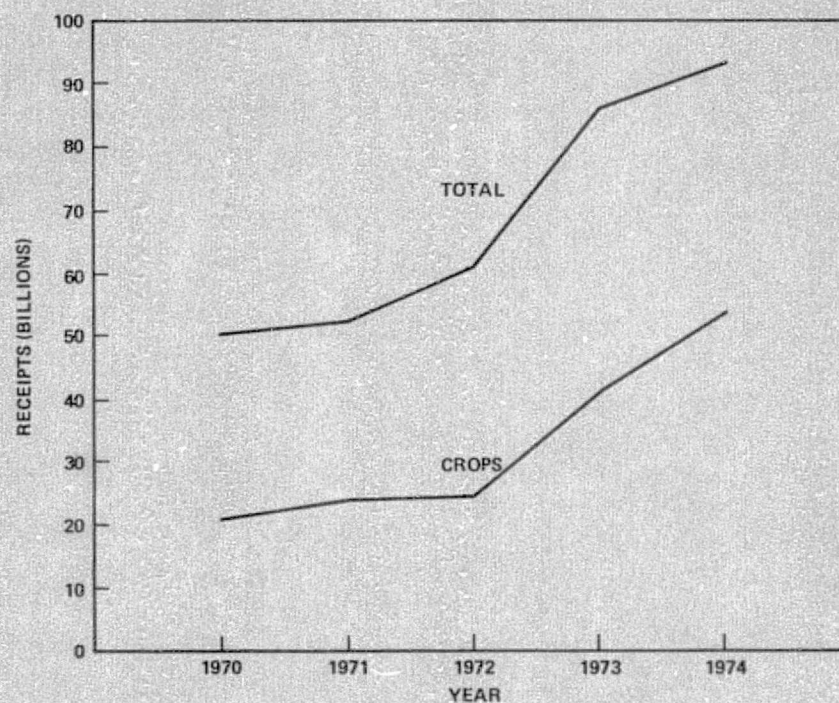
380 ACRES



1974

U.S. FARM MARKET RECEIPTS

1970 — 1974



U.S. FARM PICTURE AND MARKET RECEIPTS

FARM PICTURE

Trends in U.S. farming are toward a less labor intensive industry, smaller numbers of farms and larger farm acreages. Total acreage in cultivation is relatively constant. The trend toward larger farm acreages encourages the use of Ag-Air.

FARM RECEIPTS

Farm receipts are increasing (almost \$100 billion in 1974) with livestock accounting for almost one-half of the total. Ag-Air can increase crop productivity and, by range-land weed and pest control, also influence livestock productivity.

U.S. AGRICULTURAL AVIATION PROFILE 1974

TOTAL REVENUES/YEAR — APPLICATION ONLY

\$300,000,000

CURRENT GROWTH RATE

12%/YEAR

1400 ACFT SHIPPED

\$50,000,000 NET BILLING PRICE

1,900,000
FLT HRS/YR

6500
PILOTS

7000
AIRCRAFT

15% OF
AGRICULTURE
FERTILIZERS/
PESTICIDES

200,000,000
ACRES TREATED
(MULTIPLE APPLICATIONS)

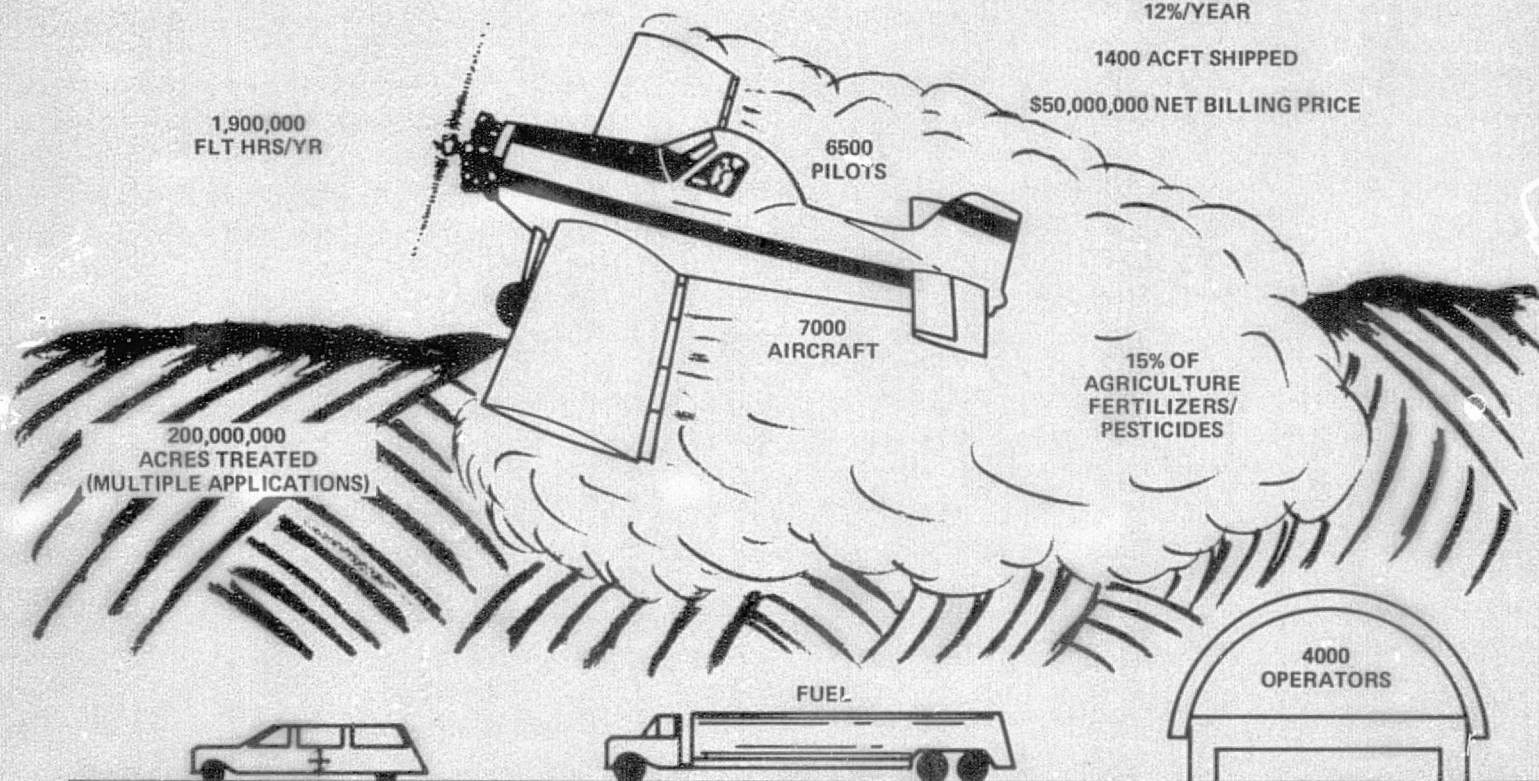
FUEL

4000
OPERATORS

ACCIDENTS — 438
FATALITIES — 29

50,000,000
GAL/YEAR

19,500
GROUND
PERSONNEL



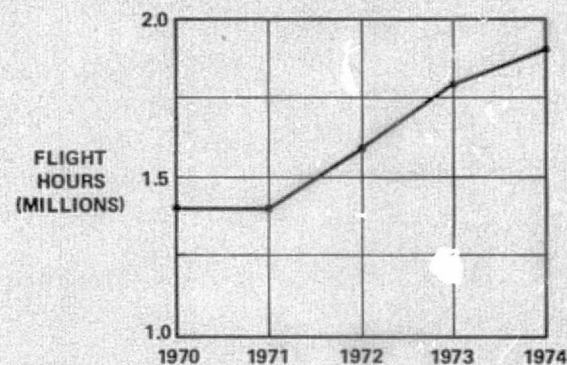
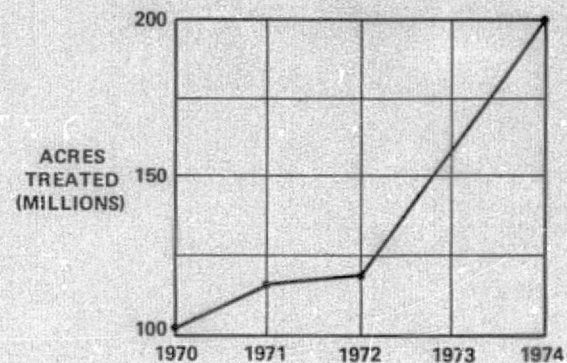
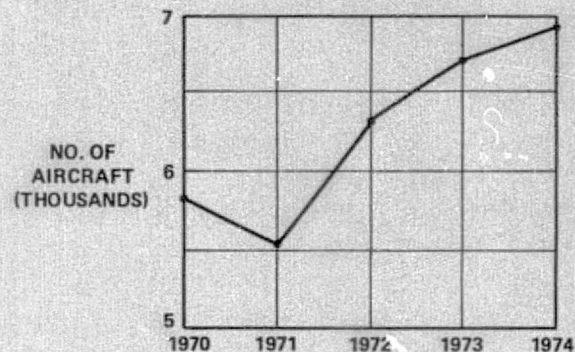
U.S. AGRICULTURAL AVIATION PROFILE 1974

- Ag-Air is big business and makes a large impact. The leather helmet-silk scarf image is long gone. "Shoe string" operators cannot survive. Significant capital investment is required to enter the business.
- 1974 Statistics:
 - \$300,000,000/year is for application only.
 - \$50,000,000 in new Ag Aircraft. Although figure is large, it will not support significant exploratory R&T within the industry.
 - 29 fatalities: fatality rate is marginally better than General Aviation. Aircraft are designed to be "walked away from." Accident rate is higher than that for General Aviation. R&T could lower rate.
 - About 25,000 people employed in industry.
 - Almost 2 million flight hours flown.

GROWTH IN U.S. AGRICULTURAL AVIATION

SUPERIORITY OF AERIAL APPLICATION OF FERTILIZERS AND PESTICIDES CONTRIBUTES TO INDUSTRY GROWTH IN SEVERAL AREAS

- CROP MANAGEMENT
- COMPACTION AVOIDANCE
- INACCESSIBLE GROUND CONDITIONS
- RAPID RESPONSE TO GROUND INFESTATION
- COST-EFFECTIVE



AG-AIR GROWTH

GROWTH IN U.S. AG-AIR

- Acres treated are growing at a higher rate than the number of new aircraft.
- Reasons for this are related to trends in aircraft design (replacement aircraft are more productive than earlier models) and to trends in application (greater percent of chemical to base; more herbicide spray; ultra-low volume sprays). These trends are in Ag-Air's favor in terms of economic considerations.

SUPERIORITY OF AERIAL APPLICATION CONTRIBUTES TO GROWTH

- **Crop management**
Ag-Air enables farmers to meet optimum planting dates; to apply chemicals at optimum periods in accordance with preplanned schedules; and to ready crops for harvest at opportune times.
- **Compaction avoidance**
Ag-Air eliminates compaction caused by the weight of tractors, trucks and

special application equipment. Crop production is increased and, in addition, non-compacted soil provides greater resistance to drought.

- **Inaccessible ground conditions**
Ag-Air affords the opportunity to apply chemicals to land, especially range land, that is otherwise inaccessible to ground application equipment.
- **Rapid response to ground infestation**
Ag-Air can cover as much acreage in one hour as a tractor can cover in one day. In addition, Ag-Air is not hindered by wet ground, a condition in which insects, disease and weeds thrive.
- **Cost-effective**
Average expenditures for air application are slightly lower than those for ground application in the U.S. However, even in those cases where air application is more expensive, increased yields still make it more profitable for farmers to use Ag-Air.

AREAS IN WHICH AERIAL APPLICATION MAKES SIGNIFICANT IMPACT

- SEEDING, FERTILIZING, PESTICIDING
- RANGE AND FOREST MANAGEMENT
- WIDE AREA PEST CONTROL (U.S.)
- WIDE AREA PEST CONTROL (FOREIGN)
- DEVELOPING NATIONS AGRICULTURAL SUPPORT

AREAS OF AG-AIR IMPACT

- **Seeding, fertilizing and pesticing**

Ag-Air does 15% of U.S. and 2% of world acreage.

- **Range and forrest management**

640 million acres of range and pasture land in U.S.; 732 million acres of forest land. World demand for timber is increasing potential for aerial fertilizer impact. The U.S., Australia and New Zealand have used aircraft to improve grazing areas by means of weed and pest control. There is tremendous opportunity for this type of work in Middle East grazing areas.

- **Wide area pest control (U.S.)**

Dept. of Agriculture aerially treats 20-30 million acres annually in state co-op programs (fire ant, gypsy moth, etc.).

- **Wide area pest control (foreign)**

World health organization has initiated a 20 year, \$120 million project to com-

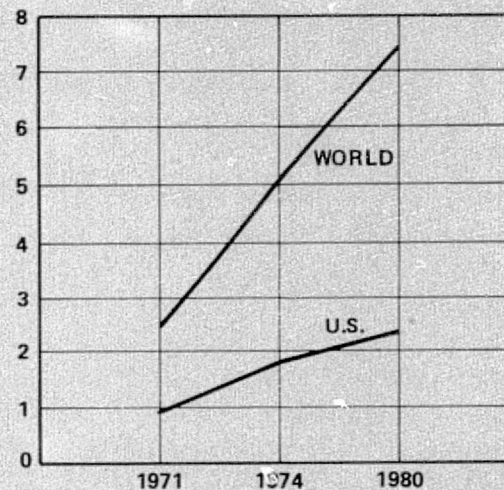
bat "river blindness" in West Africa. Aim is to rid a 400,000 sq. mi. region, including eight nations, of a parasitic infection. One million people are infected. In the fertile river valleys almost every person expects to be blind by age 40. U.N. studies indicate a return equivalent to hundreds of millions of dollars if rich valleys could be made habitable for farming.

- **Developing nations agricultural support**

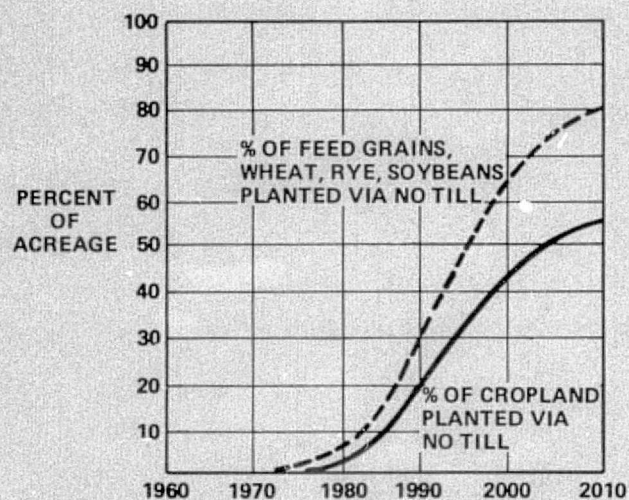
Current Ag-Air operations are taking place in Bangladesh (rice), Iran (cotton and rice), Pakistan (rice), Sudan (cotton), Egypt (cotton), Saudi Arabia (vector control), Indonesia (palm pests), Morocco (corn and cotton), Ghana (rice), Zaire (cotton, coffee and sugar cane) and in the Central African Republic (cotton).

TRENDS

DOLLARS
(BILLIONS)

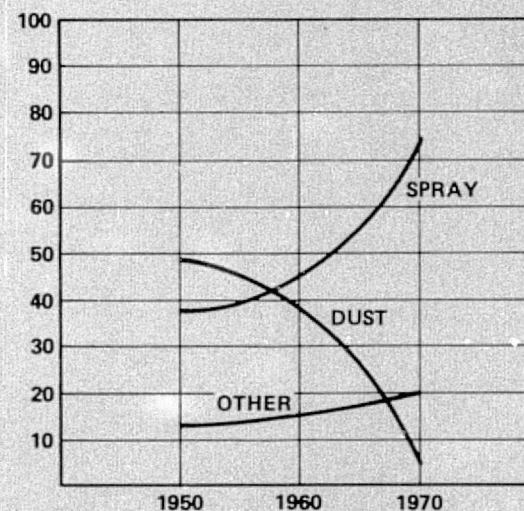


INCREASED PESTICIDE USE



GROWTH IN NO-TILL FARMING

PERCENT
OF TOTAL
TREATED
AREA



APPLICATION TRENDS

TRENDS

No-till and minimum tillage farming are techniques in which crops are directly planted without prior plowing or seedbed preparation in a sod or the residue of a preceding crop (or, in the case of minimum tillage, with reduced preparation). It also entails the use of chemical weed control in substitution for post planting cultivations. Its adoption is due primarily to the introduction of new herbicides which contribute to the reduction in preplanting weed control, including moldboard plowing and seedbed preparation.

Projected increases in no-till farming, as well as projected increases in pesticide use and in the percentage of areas treated with spray techniques, all point to increased demand for Ag-Air services.

STUDY TEAM INTERACTION

- CONTACTS WITH INDUSTRY REPRESENTATIVES
- AGRICULTURAL AVIATION WORKSHOP

COMMENTS

- PREVIOUS ADVANCES ACCOMPLISHED IN AD HOC FASHION
- DRIFT CONTROL, APPLICATION ACCURACY, AND CORROSION ARE AMONG MAJOR PROBLEMS
- NASA ENCOURAGED TO APPLY SYSTEMS APPROACH
- NAAA WILL PARTICIPATE
- SOVIETS PROPOSE JOINT EFFORTS TO ATTACK DRIFT CONTROL PROBLEM

STUDY TEAM INTERACTION

USER COMMUNITY INTERFACE

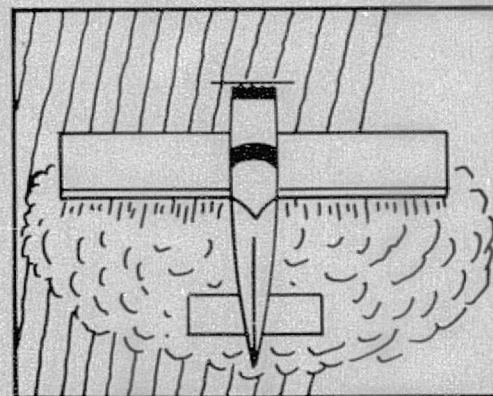
- To ensure an unbiased viewpoint all segments of the user community were contacted. Inspection visits to three different Ag-operators in Delaware and Florida were made. Piper Aircraft was visited and a special meeting was held with Cessna Aircraft. Farmers and chemical manufacturers were also contacted. A special workshop was held at the annual meeting of the National Agricultural Aviation Association, attended by a broad segment of the user population (including a Soviet delegation).
- Drift control and the related problem of precise application are the major current concerns. Current techniques result in application of twice as much chemical as required in order to ensure control. Corrosion is also a major concern.
- NASA is encouraged to take a completely fresh look at the overall systems problem and to come up with design concepts, mission analyses, mission requirements, and possibly a paper design of a new aircraft. The analyses should consider the application equipment and the aircraft as a single dispersal system. The National Agricultural Aviation Association will support this effort and will become an active participant.
- Mr. V. A. Nazarov, head of the Soviet delegation, suggested joint efforts to attack the drift control problem.

MAJOR RESULTS WERE AS FOLLOWS:

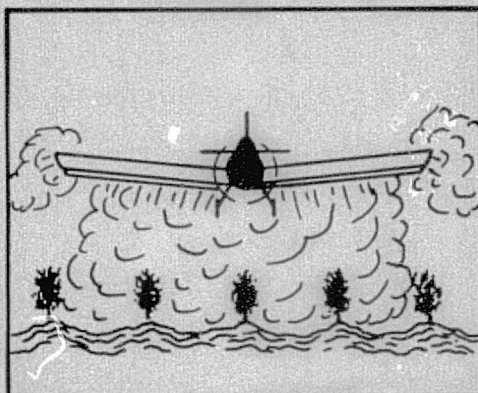
- Previous advances in aerial application technology have been accomplished in an ad hoc fashion with testing of methods accomplished using fields of cooperative farmers. This procedure is not adequate for required future advances.

PROBLEMS IN AGRICULTURAL AVIATION

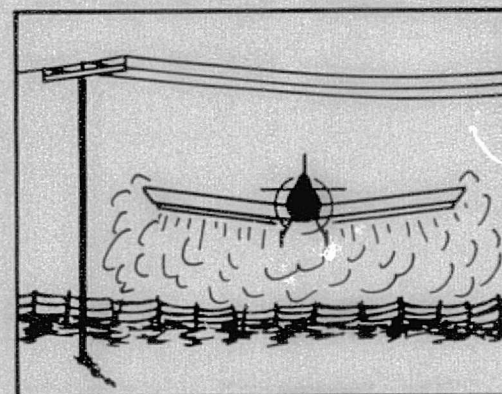
- CORROSION CONTROL
- SHORTFIELD PERFORMANCE
- FERRY SPEED



DISTRIBUTION SYSTEM
ACCURACY



AERODYNAMIC INTERACTION
WITH DISTRIBUTION SYSTEM



HANDLING QUALITIES
MANEUVERABILITY
PERFORMANCE

PROBLEMS IN AGRICULTURAL AVIATION

Ag-Air problems include those relating to the aircraft, the distribution system and the flow field (which includes the atmosphere as well as terrain and crop characteristics).

No single problem can be said to outweigh all others, but three significant problem areas are depicted: distribution system accuracy; aerodynamic interaction with distribution system; handling qualities, maneuverability, performance.

Three other problems, while not foreign to other general aviation aircraft, are of more critical concern to Ag-Air operators: corrosion control; shortfield performance; and ferry speed. Farm chemicals are highly corrosive and Ag aircraft must operate from short, rugged fields with a minimum amount of time lost to ferrying chemicals to the field.

Safety of personnel, weather phenomena and certain regulations restricting equipment types are other problem areas which will benefit from R&T efforts.

AGRICULTURAL AVIATION PROBLEM AREAS

AIRCRAFT

- DESIGN/PERFORMANCE
- PROPELLERS
- AIRFOILS
- CORROSION
- WING TIP VORTEX PHENOMENA

APPLICATION SYSTEMS

- DESIGN/PERFORMANCE
- PROFILE DRAG
- UNIFORMITY OF COVERAGE
- NOZZLE SYSTEMS
- FLAGGING SYSTEMS
- EVALUATION AFTER APPLICATION

SAFETY

- FATIGUE/TEMPO OF OPS.
- COCKPIT ENVIRONMENT
- AIRCRAFT PERFORMANCE
- CRASHWORTHINESS
- PROTECTIVE GEAR
- CHEMICAL HANDLING SYSTEMS

OTHER

- WEATHER
- AVAILABILITY OF FUELS AND CHEMICALS
- REGULATIONS

APPLICABLE NASA RESEARCH AND TECHNOLOGY

- NASA AIRFOIL DEVELOPMENT
- DRAG REDUCTION
- PROPULSION EFFICIENCY
- CRASHWORTHINESS
- STALL/SPIN

APPLICABLE NASA RESEARCH AND TECHNOLOGY

Ongoing NASA R&T relating to airfoil development, drag reduction, propulsion efficiency, crashworthiness and stall/spin characteristics relate directly or indirectly to Ag-Air problem areas.

Other NASA R&T results (such as nozzle droplet formulation characteristics) may apply directly to Ag-Air application problems.

NASA SPECIAL SKILLS AND FACILITIES

- WIND TUNNELS
- SIMULATORS
- COMPUTER PROGRAMS
- DATA BASES
- SYSTEMS ANALYSES
- EXPERIENCE IN GENERAL AVIATION
- PROGRAM MANAGEMENT AND COORDINATION

NASA SPECIAL SKILLS AND FACILITIES

In addition to specific research, NASA can bring to bear unique interdisciplinary systems analysis skills and facilities including:

- Simulators and computer skills to test new aircraft/dispersal characteristics
- Wind tunnels to test promising designs
- Interagency cooperative programs to conduct field tests of dispersal characteristics
- Systems analyses to match the technology to the economic reality of the required operations.

POTENTIAL BENEFITS OF NASA R&T

- REDUCTION IN \$75 BILLION ANNUAL WORLD CROP LOSS DUE TO PESTS, PLANT DISEASES AND WEEDS
- INCREASE IN AGRICULTURAL PRODUCTIVITY THROUGH COMBINATION OF AG-AIR AND OTHER TECHNOLOGY IMPROVEMENTS (NO-TILL)
- REDUCTION IN ENVIRONMENTAL IMPACT OF CHEMICAL APPLICATION DUE TO INCREASED PRECISION OF AERIAL APPLICATION
- POSITIVE IMPACT ON U.S. GNP AND BALANCE OF TRADE
- SOCIAL BENEFITS IN REDUCTION OF ILLNESS AND MALNUTRITION IN DEVELOPING NATIONS
- AIR IS POTENTIALLY A MORE FUEL CONSERVATIVE MODE THAN GROUND APPLICATION (9:1).
- U.S. POSTURE IN INTERNATIONAL AG-AIR MARKETPLACE WILL BE ENHANCED

POTENTIAL BENEFITS OF NASA R&T

- Analysis of potential benefits has not yet been accomplished. However, the work which has been accomplished gives good insights into where the benefits will be and some limits on the amount of these benefits.
- Previous application trends and new farming developments (no-till) all point to increased use of pesticides. Private industry surveys and projections confirm these trends. If the benefits implied by use of pesticides are to be realized, then the potentially harmful environmental effects must be minimized by accurate application. This is the area where NASA research can make the most significant contribution.

SUMMARY

- AGRICULTURAL AVIATION IMPORTANT AND GROWING
- SUBSTANTIAL PROBLEMS EXIST
- PRODUCTIVITY INCREASES POSSIBLE
- STRONG RATIONALE FOR NASA INVOLVEMENT EXISTS
- APPARENTLY A HIGH PAYOFF AREA WITH GREAT SOCIAL BENEFITS

The findings of the Ag-Air Study prompted the development of a NASA Ag-Air R&T Program Plan. The proposed program plan is presented in Part II which follows.

**Agricultural
Aviation
Program Plan**

PART II

Program Goals and Objectives

Program Goal

To contribute to the solution of world food problems through aeronautical technology.

Program Objectives

To develop new technology for short-, mid- and long-term improvements in Ag-Air performance that will impact favorably on agricultural productivity.

- Improved aerodynamic and structural performance
- Increased distribution system accuracy
- Increased system efficiency and safety
- Improved environmental safeguards
- Reduced energy consumption

OVERALL PROGRAM APPROACH

- MISSION AND ECONOMIC ANALYSIS STUDIES

- AIRCRAFT SYSTEM STUDIES

- SUBSYSTEM DESIGN STUDIES

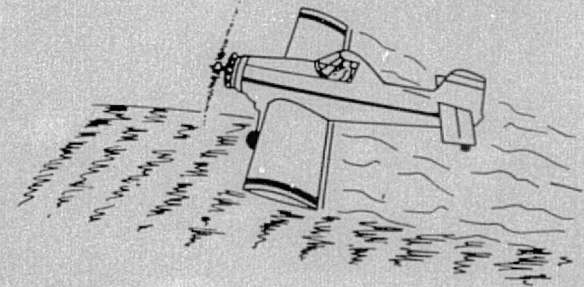
- SUBSYSTEM R + T

- SIMULATIONS

- WIND TUNNEL TEST

- RESEARCH AIRCRAFT

- INTERAGENCY IMPLEMENTATION
- INDUSTRY INTERFACE



OPEN FIELD TESTS, VERIFICATIONS
AND DEMONSTRATIONS

OVERALL PROGRAM APPROACH

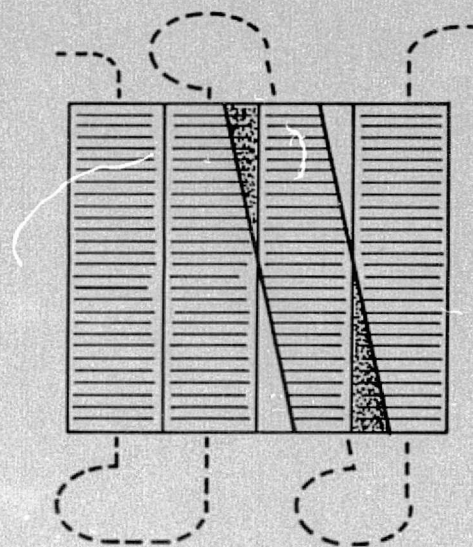
The NASA Ag-Air R&T Program Plan will employ a systems analysis approach wherein the aircraft, dispersal and flow field are considered a single system.

The results of Ag-Air mission and economic analyses will be integrated with aircraft and subsystem studies to define areas for potentially fruitful R&T efforts.

Inputs from other government agencies, such as the U.S. Department of Agriculture, and from industry representatives will be included in defining and implementing R&T efforts.

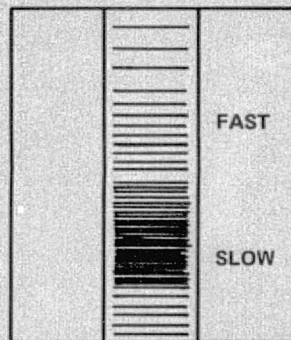
NASA research centers will conduct appropriate R&T programs ultimately resulting in open field tests, verifications and demonstrations.

EFFECT OF FLIGHT PATH CONTROL ON DISTRIBUTION ACCURACY



NASA EXPERTISE IN:

- PRECISE GUIDANCE
- SENSORS
- STABILITY AND CONTROL
- HANDLING QUALITIES



ALTITUDE

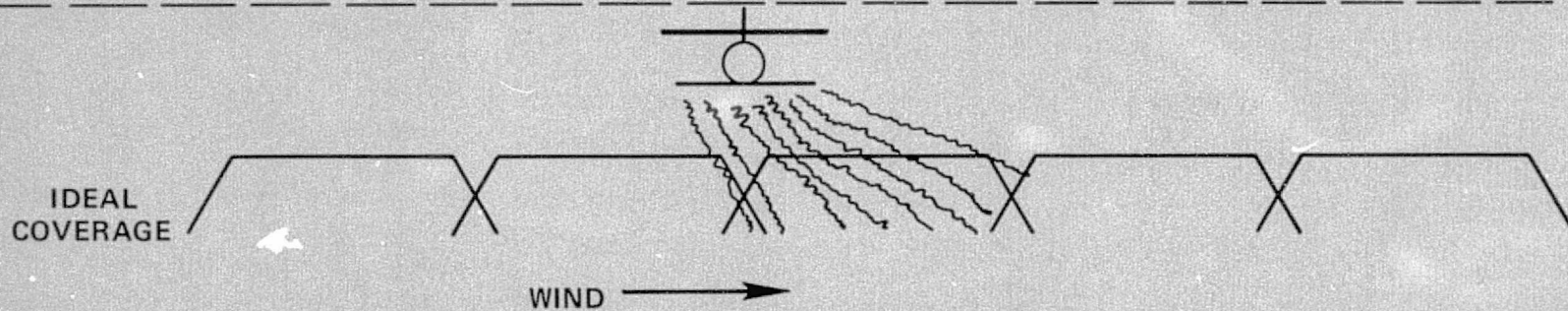
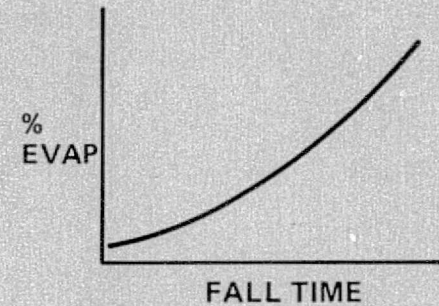
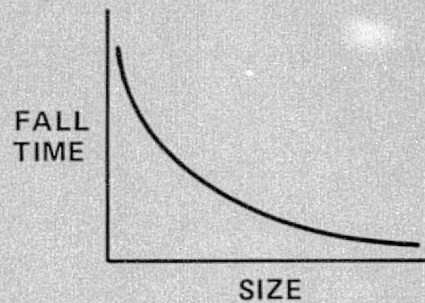
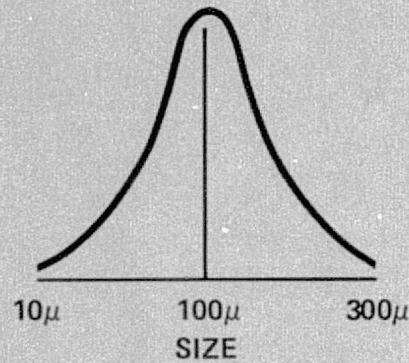
AIRCRAFT SUBSYSTEM RESEARCH

The effect of flight path control on distribution accuracy is representative of areas where improvements are possible through R&T efforts. Improved aircraft guidance and stability subsystems will enhance the ability of the Ag-Air operator to apply chemicals easily and accurately.

Other aircraft subsystem research efforts will be directed toward improvements in drag reduction, propulsion efficiency, corrosion control and cockpit environmental safety.

DISPERSAL SYSTEM RESEARCH

EFFECT OF DROPLET SIZE ON DISTRIBUTION ACCURACY



EFFECT OF
VARIABLE
FALL TIME



NASA EXPERTISE IN:

- NOZZLE DESIGN FOR UNIFORM DROPLET SIZE

DISPERSAL SYSTEM RESEARCH

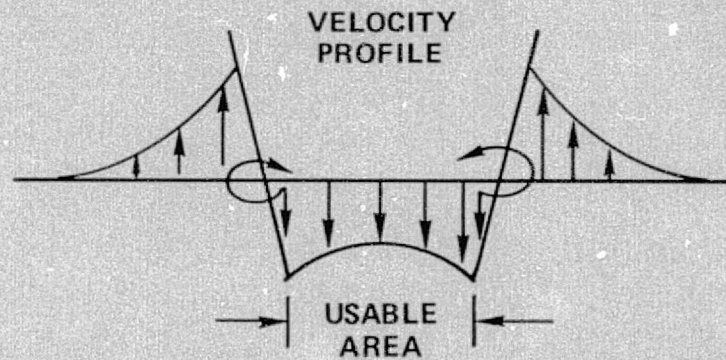
One factor of particular significance to the aircraft chemical dispersal system is the effect of droplet size on distribution accuracy. The size of a chemical droplet affects the time of fall and the evaporation rate as well as the wind effect on the droplet during fall. NASA expertise in designing nozzles which provide uniform droplet size may well be applicable to chemical dispersal systems.

Other dispersal system research efforts will be directed toward:

- Eliminating leakage and spillage
- Developing improved plumbing and valves
- Developing corrosion resistant materials
- Designing loading and handling equipment that is efficient and which provides a greater measure of safety to ground personnel

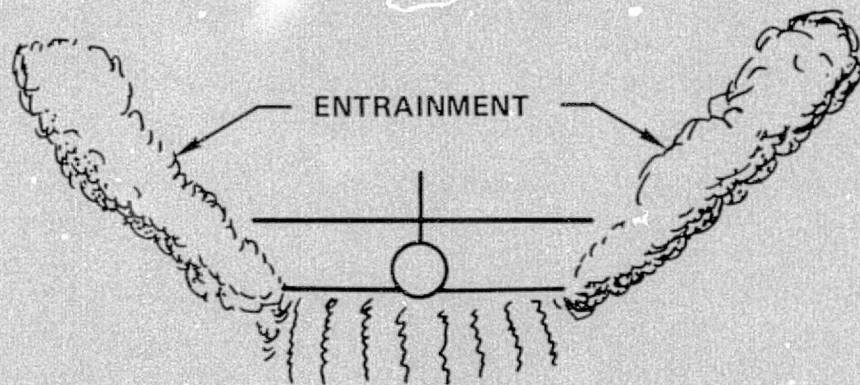
FLOW FIELD RESEARCH

EFFECT OF AIRCRAFT FLOW FIELD
ON DISTRIBUTION ACCURACY



NASA EXPERTISE IN:

- VORTEX ALLEVIATION



FLOW FIELD RESEARCH

The aircraft flow field is another example of a factor which impacts on distribution accuracy. NASA expertise in vortex alleviation can prove useful in developing air foil and distribution system designs that will minimize the adverse effects of the aircraft flow field on distribution accuracy.

Other flow field factors impacting on distribution accuracy which warrant research include weather phenomena, the nature of the crop and the characteristics of the terrain being treated.

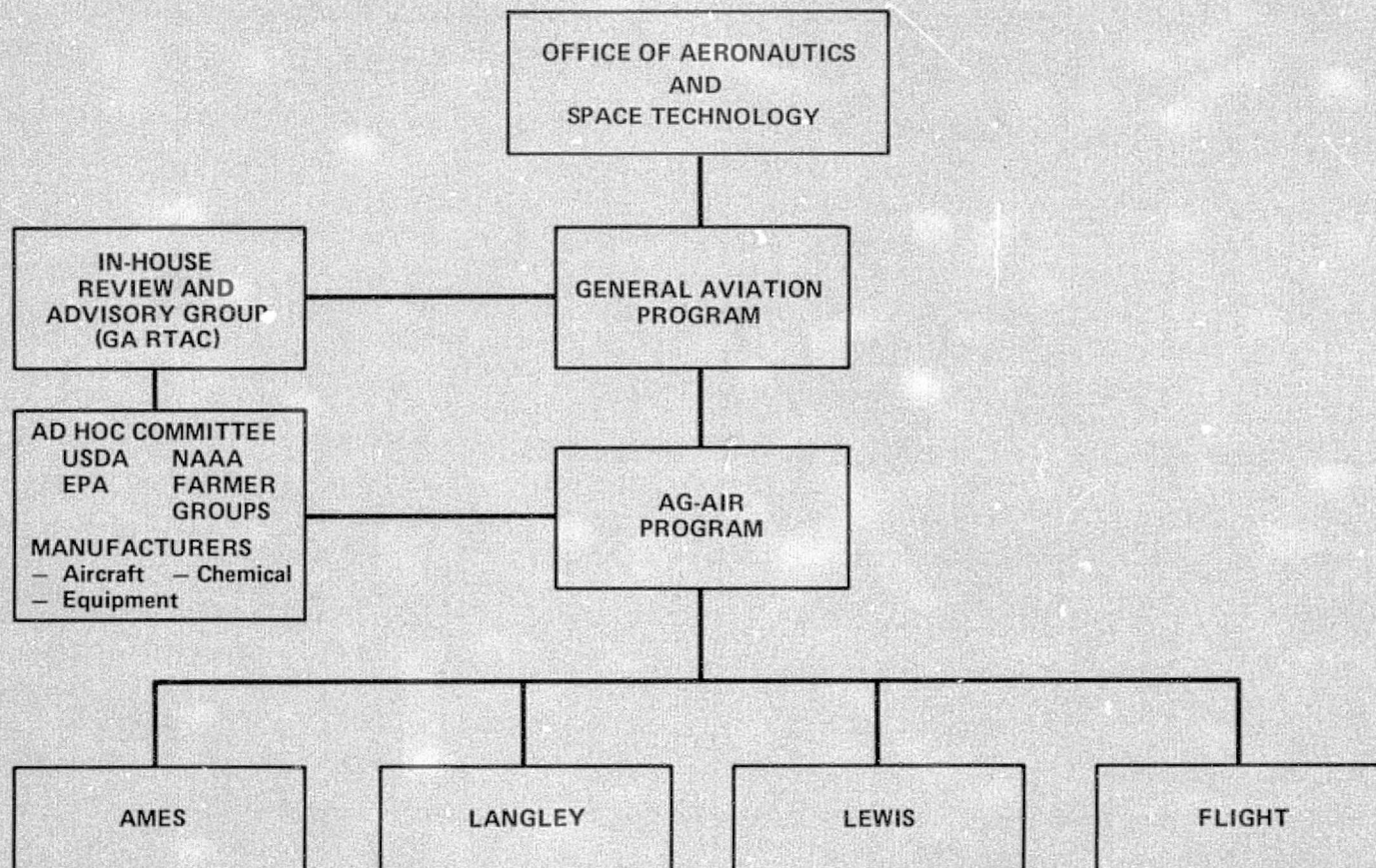
ANTICIPATED RESULTS

AIRCRAFT, DISPERSAL SYSTEM AND FLOW FIELD IMPROVEMENTS
WILL PROVIDE FOR:

- IMPROVED OPERATING EFFICIENCIES
 - AG AIRCRAFT SYSTEM PRODUCTIVITY
 - REDUCED ENERGY CONSUMPTION
- LONG-TERM ECONOMIC BENEFITS
 - INCREASED WORLD AGRICULTURAL PRODUCTIVITY
- SOCIAL BENEFITS
 - ENVIRONMENTAL IMPACT
 - HEALTH IMPROVEMENT THROUGH WIDE AREA PEST CONTROL

General management, technical and budgetary plans for achieving these positive results are presented in the following pages. Detailed program implementation plans will be drawn at a later date.

FUNCTIONAL PROGRAM ORGANIZATION



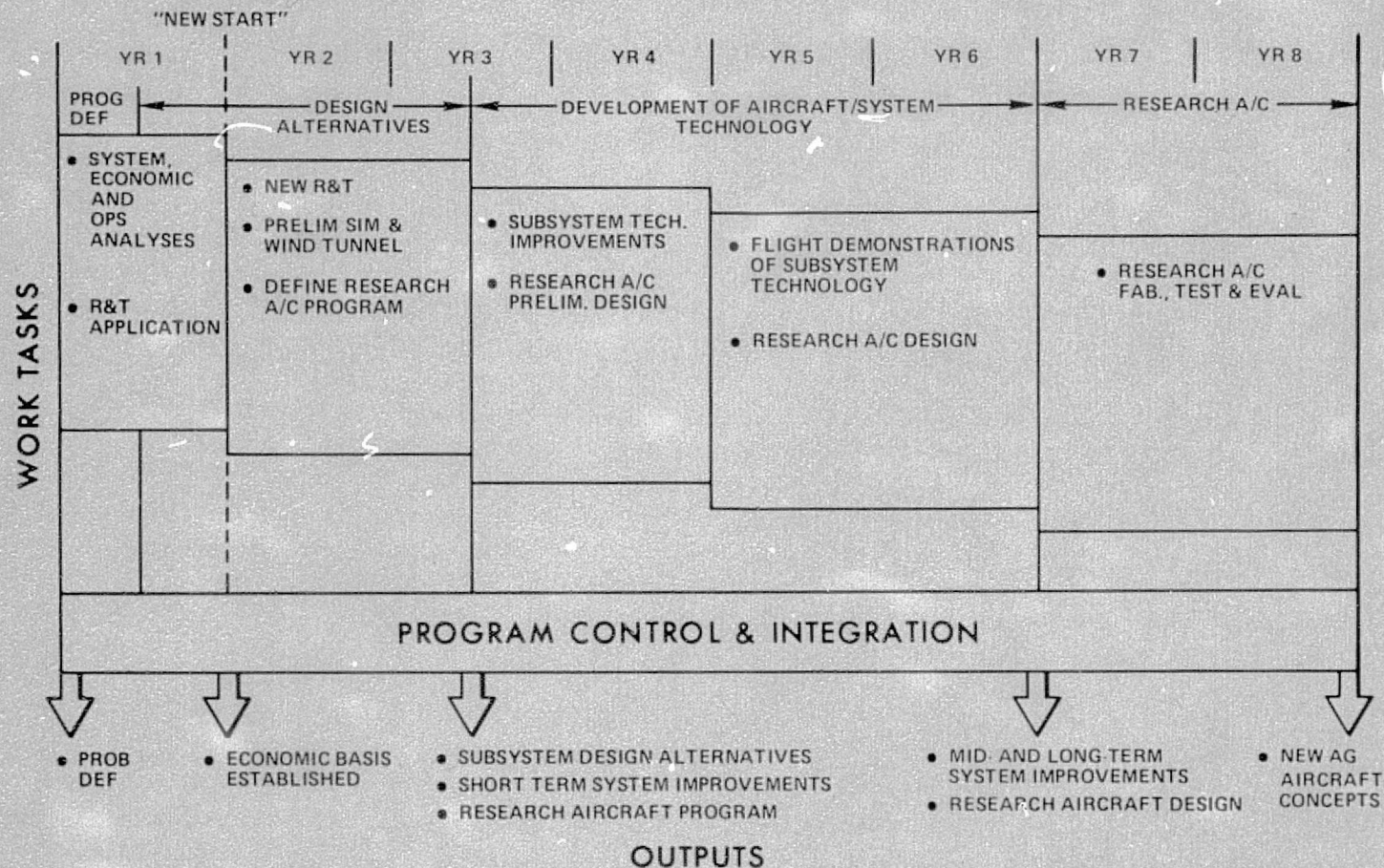
FUNCTIONAL PROGRAM ORGANIZATION

The Ag-Air R&T Program will be directed by the Associate Administrator, Aeronautics and Space Technology, and will be carried out as an integral part of the OAST General Aviation Program.

An In-House Review and Advisory Group will monitor program plans and results. A separate Ad Hoc Committee on Ag-Air, composed of various government and industry representatives will actively participate in planning and monitoring the program.

NASA Research Centers, which have already contributed inputs to the development of this program plan, will continue to participate in further program planning as well as in the execution of specific research efforts.

OVERVIEW OF TECHNICAL PLAN



OVERVIEW OF TECHNICAL PLAN

The NASA Ag-Air Program Technical Plan is designed to provide short-, mid- and long-term Ag-Air system improvements. The option exists however, to include a research aircraft while at the same time continuing R&T efforts toward improving existing aircraft systems.

The technical plan is designed to include a detailed program definition phase wherein systems, economic and operations analyses will be performed to determine those research areas which offer the highest potential for Ag-Air improvements. The plan also allows two and one-half years to research design alternatives before making a go-ahead decision on a research aircraft.

Program control and integration will be provided by the Office of Aeronautics and Space Technology assisted by a lead center.

CENTER SUBSYSTEM RESEARCH AREAS

- AIRCRAFT SUBSYSTEMS

- AERODYNAMIC PERFORMANCE
OPERATING CHARACTERISTICS
(AIRFOIL RESEARCH)
- HANDLING QUALITIES AND
PERFORMANCE (FIXED AND
ROTARY WING)
- ENVIRONMENTAL/COCKPIT
DESIGN
- NAVIGATION AND GUIDANCE
SYSTEMS (FLAGGING SYSTEMS)

- AIRCRAFT SUBSYSTEMS

- EXISTING ENGINES
- ALTERNATE ENGINES
- NEW AG-AIR ENGINE
- COMPOSITE PROPELLERS

- DISPERSAL SYSTEM

- SPRAY NOZZLES
- SPREADERS
- CHEMICAL PLUMBING
(VALVES)
- AUXILIARY POWER FOR
SPREADERS

VERIFICATION OF SIMULATION
AND WIND TUNNEL TESTS AND
OPEN FIELD TESTING

- AIRCRAFT SUBSYSTEMS

- CORROSION CONTROL

- FLOW FIELD SUBSYSTEM

- SPRAYER/SPREADER FLOW
FIELD CHARACTERISTICS
- FLOW FIELD DISTRIBUTION
PATTERNS
- AIRCRAFT/FLOW FIELD
INTERACTION
- ATMOSPHERIC INTERACTION
- DRIFT CONTROL
- SWATH WIDTH

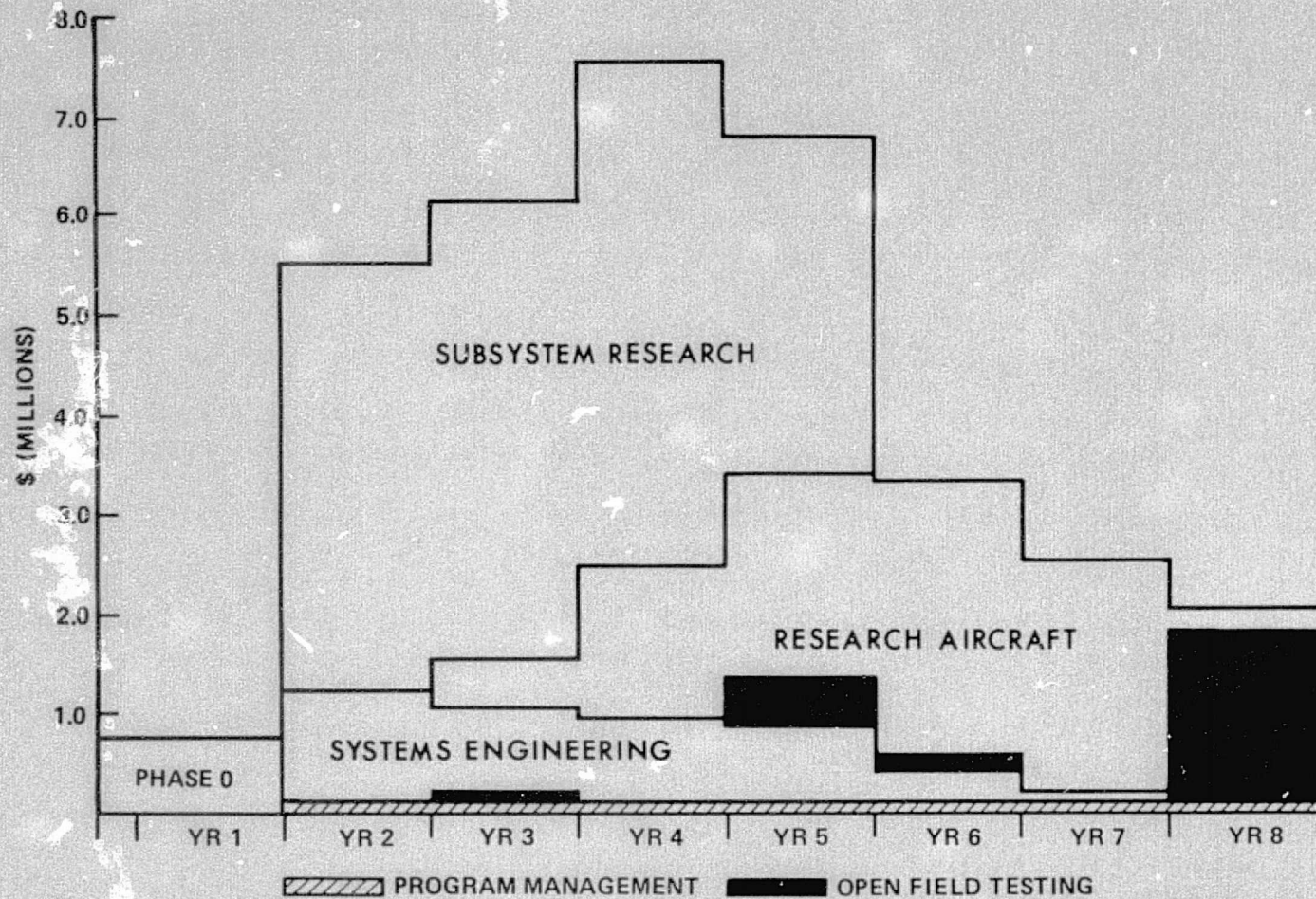
CENTER SUBSYSTEM RESEARCH AREAS

The Ag-Air Technical Plan takes advantage of the skills, facilities and expertise available at each of the research centers. Areas for research will be assigned each center with overall coordination provided by the Office of Aeronautics and Space Technology.

Research Areas listed are not intended to represent a complete list of activities included in this program.

In conducting research in the areas shown, Langley Research Center is being considered for the role of lead center.

PROGRAM BUDGET SUMMARY



PROGRAM BUDGET SUMMARY

The Ag-Air R&T Program Budget proposes the expenditure of \$35 million over an eight year period for Ag-Air technological improvements. The \$35 million figure includes \$10 million for the design, fabrication, test and evaluation of a flying test-bed if that is proven to be required.

A decision to eliminate the research aircraft would reduce the program budget by \$10 million but would not alter remaining program structures or goals.

Initial funding will support detailed analyses with the intent of providing firm rationale for the full-scale program.